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(54) Low voltage power control breaker.

(57) Low voltage power control breaker that can work with different overload curves with no need to carry out any physical change in the power control breaker, and which can be operated remotely.

It consists of a set of pulse reading modules (L1, L2,..., Ln), an instantaneous power calculating module (1), a programmable overload curve module (4), a driver module (3), a set of contactors (I1, I2,..., In), a push-switch status reading module (5), a set of push-switches (P1, P2,..., Pn), and a communications module (2).

The breaker ensures that when a contactor is opened on having received a remote command through the communications module (2), the corresponding customer is unable to close the contactor locally by operating the corresponding push-switch.

Likewise, the breaker ensures that if a contactor has been opened locally, the contactor cannot be closed as a result of a remote command received through the communications module (2).

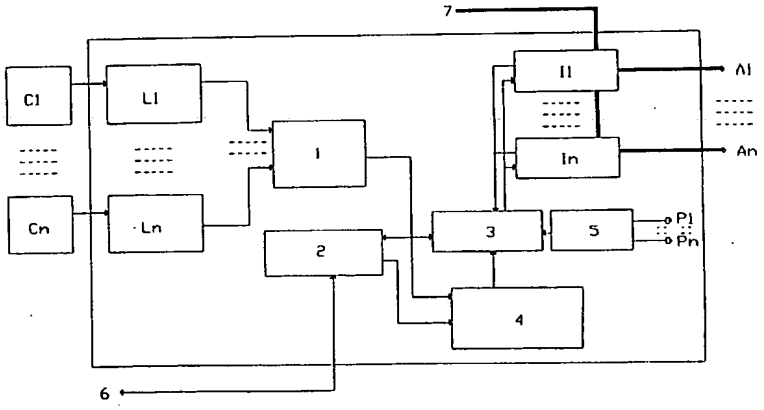

FIG. 1

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OBJECT OF THE INVENTION

This invention, as already stated in the title of this document, concerns a low voltage power control breaker, that is of special application in low voltage electric power user distribution networks, and that can work with different overload curves with no need to carry out any physical change in the breaker, and that can be operated remotely.

BACKGROUND TO THE INVENTION

At present, there exist power control breakers whose construction is based on a bimetal strip that generally operates according to a thermal trip curve or an overload curve fixed by the characteristics of the bimetal strip.

This curve is fixed for each power control breaker and is regulated by the VDE0660 and IEC292-1 standards. As this overload curve is fixed, when the user wishes to change his contracted power, which is equivalent to another overload curve, it is necessary for the electric utility, in order to continue limiting the maximum power usable by the customer, to physically replace the existing power control breaker with another prepared for the new power contracted, this forming a serious inconvenience.

The resetting of the present power control breakers can be done:

- manually, intervening directly on the device,
- automatically, by the cooling of the bimetal strip, or
- by means of an auxiliary contact, which can be accessed over two wires.

Consequently, the existing power control breakers cannot be operated on remotely by the electric utility, which also constitutes a serious inconvenience.

In the publication "Automática e Instrumentación", Reports 89/90, pages 227 to 245, different types of existing breakers are described, all presenting the inconveniences mentioned above.

TECHNICAL PROBLEM TO BE SOLVED

Thus, the technical problem to be overcome consists in making the power control breakers able to work with different overload curves with no need to carry out any physical change in the power control breaker, as well as to achieve that these can be operated remotely.

CHARACTERISATION OF THE INVENTION

To overcome the inconveniences mentioned above, the invention proposes the replacement of the bimetal device of the conventional power control breakers by an electronic control circuit that can be programmed remotely.

The invention is characterised in that it comprises a set of pulse reading modules connected to the corresponding customer meters and to an instantaneous power calculating module, which collect the pulses provided by the different customer meters.

The instantaneous power calculating module, also connected to a programmable overload curve module, is calculating the instantaneous power demands of the different customers at every moment.

The invention is also characterised in that the programmable overload curve module is also connected to a driver module and to a communications module, which decides the status in which each of the contactors should be.

The driver module is also connected to the communications module, to a push-switch status reading module and to the set of contactors, connected in turn to the different low voltage customer circuits, and enables or inhibits each of the contactors according to the commands received from the programmable overload curve module, from the communications module or from the push-switch status reading module, and also takes into account the state in which the different contactors are.

The invention is also characterised in that the push-switch status reading module, that is also connected to a set of push-switches, reads the commands given locally through the push-switches.

Similarly, the communications module is connected, via a communications line, to a remote centre to which it transmits information on the status of the contactors and, from which it receives commands to change the overload curve to use with any one of the contactors or to change the state of said contactor.

An additional characteristic of the invention is that the corresponding customer has no facility to close his contactor locally by means of the corresponding push-switch when the contactor is opened by a remote command coming through the communications module.

Finally, the invention is also characterised in that when the contactor of a customer is opened locally as the result of a command transmitted through the corresponding push-switch, said contactor cannot be closed in response to a command received remotely through the communications module.

Consequently, by means of the invention, load control for various customers is centralised, permitting them to vary the power contracted with no need to carry out any physical change in the breakers.

Next, in order to make this description clearer, and forming an integral part thereof, a series of

figures are attached in which by way of illustration, and in no way limiting, the object of the invention is shown.

BRIEF FOOTNOTES TO THE FIGURES

Figure 1 shows the functional block diagram of the low voltage power control breaker in accordance with the invention.

Figure 2 shows a power overload curve, the theoretical curve being the broken line and the approximate curve being the sections of continuous line, and illustrating the operation of the power control breaker of the invention.

DESCRIPTION OF AN EXAMPLE OF IMPLEMENTATION OF THE INVENTION

Below a description of the invention based on the figures mentioned above is given.

It is common knowledge that the power consumed by each customer can be controlled by means of a meter Ci installed by the electric utility. After this meter is mounted the power control breaker by means of which a limit is put on the maximum power consumable, this power corresponding to that contracted by the customer.

The conventionally used meters are fitted with a pulse transmitter in accordance with the standard DIN 43864, or similar, whereby the frequency of the pulses emitted is a function of the consumption.

Each of the customer meters Ci is connected to a pulse reading module Li, and all of these are connected to an instantaneous power calculating module 1 which, in turn, is connected to a programmable overload curve module 4.

In addition, the invention has a communications module 2 that is connected to a communications line 6, and to the programmable overload curve module 4.

The communications line 6 can be formed by a dedicated pair or tie-line, an optical fibre, the low voltage network, a radiolink, etc., such that communication is possible between the breaker of the invention and a remote point where is located the control equipment that facilitates the control and programming of the breaker.

On the other hand, the communications module 2 is also connected to a driver module 3 which, in turn, is linked to a push-switch status reader module 5 and to as many contactors I1,..., In as there are customers.

The contactors I1,..., In perform the connection/disconnection between the low voltage network 7 and the low voltage line corresponding to the customer A1,..., An.

The pulse reading module Li connected to the corresponding meter Ci has the job of collecting the pulses generated by the meter to which it is connected.

The pulses collected by the pulse reading module Li are sent to the instantaneous power calculating module 1, which calculates the power required by the customer at each moment, as a function of the number of pulses detected per integration time interval.

The instantaneous power calculated for each customer is sent to the programmable overload curve module 4 which holds inside the overload curve for each of the subscribers, determining whether the instantaneous power demanded by each customer exceeds that contracted, and deciding the state in which each of the contactors I1, I2,..., In should be.

The overload curve for each customer can be programmed from a remote point that includes a control equipment connected to the communications line 6 and to the breaker of the invention through the communications module 2.

In addition, the driver module 3 is aware at all times of the state of each of the breakers I1,..., In, corresponding to the different customers, such that the remote control equipment has access to this information.

The information contained in the programmable overload curve module 4 is in the form of tables, mathematical formulae, electrical characteristics of mechanical or electronic components, or any other means, whereby this information can be modified exactly as has been already indicated, permitting a change to be made in the contracted power without it being necessary to alter any physical element.

Consequently, the programmable overload curve module 4 has the job of determining at what moment and based on what parameters a contactor cut-out is to be done, just as will be commented below.

If a contactor Ii is opened from the control equipment located at a remote point, the driver module 3 prevents the customer from being able to close the contactor locally by means of the corresponding push-switch Pi.

Likewise, if the customer locally opens his contactor Ii by means of the corresponding push-switch Pi, the driver module 3 prevents this contactor Ii from being closed from the control equipment located at the remote point.

The calculation of the instantaneous power is done from the constant associated with each meter Ci, which represents the power consumed for each pulse generated, such that the instantaneous power is obtained by dividing this constant by the time elapsing between two pulses.

For each meter there is a power overload curve, like for example that shown in figure 2. This curve represents the cut-out time Tc, as a function of the instantaneous power.

For each power value above that contracted, there is a corresponding fixed cut-out time. This time is the maximum for which this level of power can be allowed before the cut-out or opening of the corresponding contactor takes place.

The power requested P is sampled at fixed intervals of time δt. With each sample, the time, Tcut-out, until the cut-out or opening of the contactor takes place, is recalculated; the situation will be one of the following:

a) if $P_n \leq K^*Pnominal$, then $Tcut\text{-}out_n = \infty$, where K is the permissible overload factor;

b) if $Tcut\text{-}out_{n-1} = \infty$ and $P_n > K^*Pnominal$, then $Tcut\text{-}out_n = Tc(P_n)$, according to the curve of figure 2;

c) if the power requested was variable and greater than K*Pnominal, the time until cut-out takes place at instant n, is given by:

$$Tcut\text{-}out_n = (Tcut\text{-}out_{n-1} - \delta t)^*Tc(P_n)/Tc(P_{n-1});$$

d) if the power requested was constant and greater than K*Pnominal, the preceding expression simplifies to:

$$Tcut\text{-}out_n = Tcut\text{-}out_{n-1} - \delta t.$$

When, for any given customer, the cut-out time is equal to zero, the corresponding contactor Ii is opened through a command from the driver module 3. The time the contactor remains open is programmable. Once this time has elapsed, resetting happens automatically or the contactor stays open indefinitely, depending on the number of cut-outs that have already occurred.

Claims

1. LOW VOLTAGE POWER CONTROL BREAKER comprising:
   - a set of pulse reading modules (L1, L2,..., Ln) connected to the corresponding customer meters (C1, C2,..., Cn) and to an instantaneous power calculating module (1), which collect the pulses provided by the different customer meters (C1, C2,..., Cn);
   - an instantaneous power calculating module (1), also connected to a programmable overload curve module (4), and which is constantly calculating the instantaneous power demands of the different customers;
   - a programmable overload curve module (4), also connected to a driver module (3) and to a communications module (2), which decides the status in which each of the contactors (I1, I2,..., In) should be;
   - a driver module (3), also connected to the communications module (2), to the push-switch status reading module (5) and to the set of contactors (I1, I2,..., In), and which enables or inhibits each of the contactors (I1, I2,..., In) according to the commands received from the programmable overload curve module (4), from the communications module (2) or from the push-switch status reading module (5), and taking also into account the state in which the different contactors are;
   - a set of contactors (I1, I2,..., In) connected to the different low-voltage customers (A1, A2,..., An);
   - a push-switch status reading module (5), connected to a set of push-switches (P1, P2,..., Pn), which reads the commands given locally through the push-switches (P1, P2,..., Pn);
   - a set of push-switches (P1, P2,..., Pn); and
   - a communications module (2), connected via a communications line (6) to a remote centre to which it transmits information on the status of the contactors (I1, I2,..., In) and, from which it receives commands to change the overload curve to use with any one of the contactors (Ii) or to change the state of said contactor.

2. LOW VOLTAGE POWER CONTROL BREAKER according to claim 1, characterised in that the corresponding customer has no facility to close his contactor (Ii) locally by means of the corresponding push-switch (Pi) when the contactor is opened by a remote command coming through the communications module (2).

3. LOW VOLTAGE POWER CONTROL BREAKER according to claim 1, characterised in that when the contactor (Ii) of a customer is opened locally as the result of a command transmitted through the corresponding push-switch (Pi), said contactor cannot be closed in response to a command received remotely through the communications module (2).

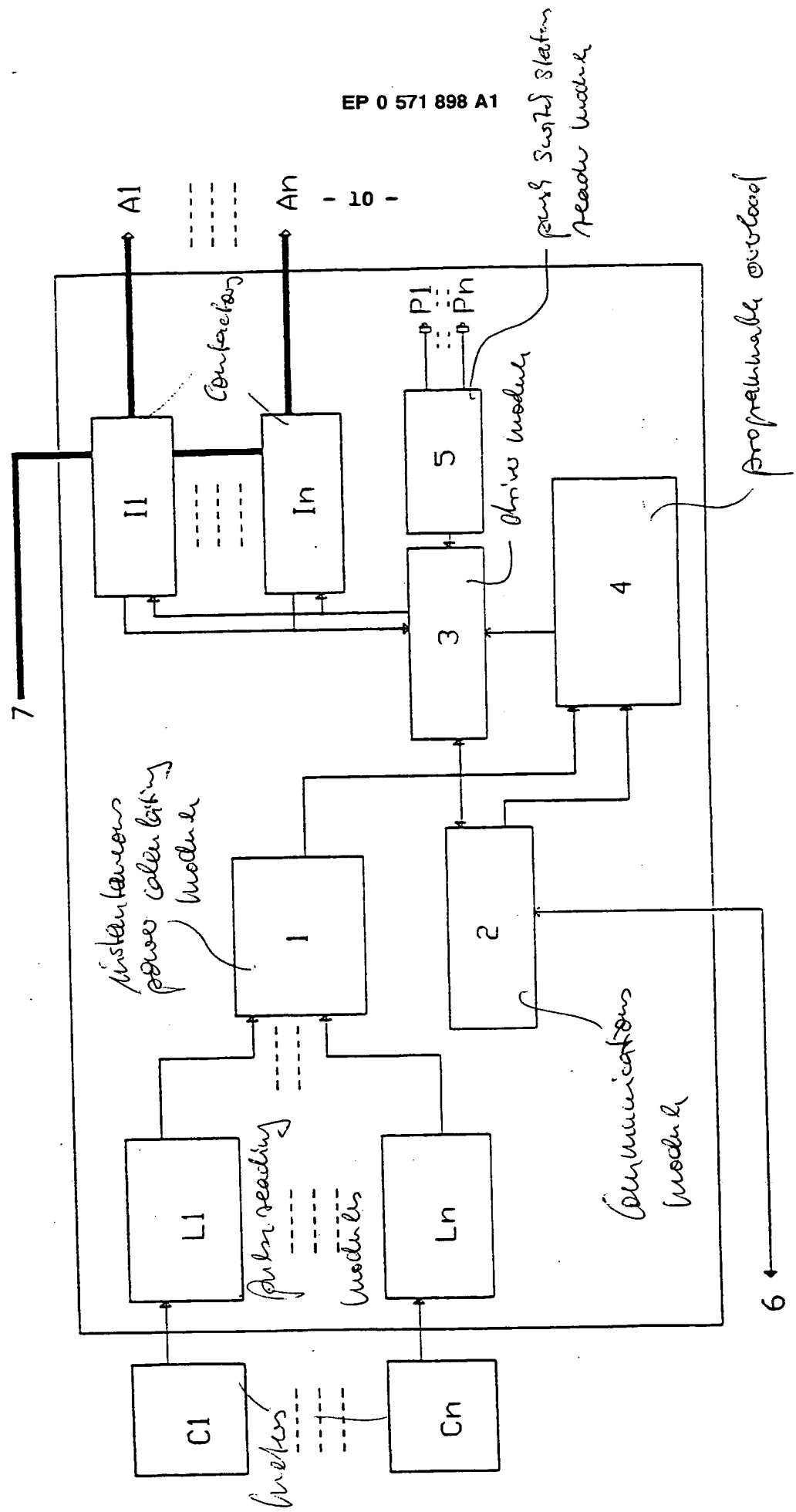

FIG. 1

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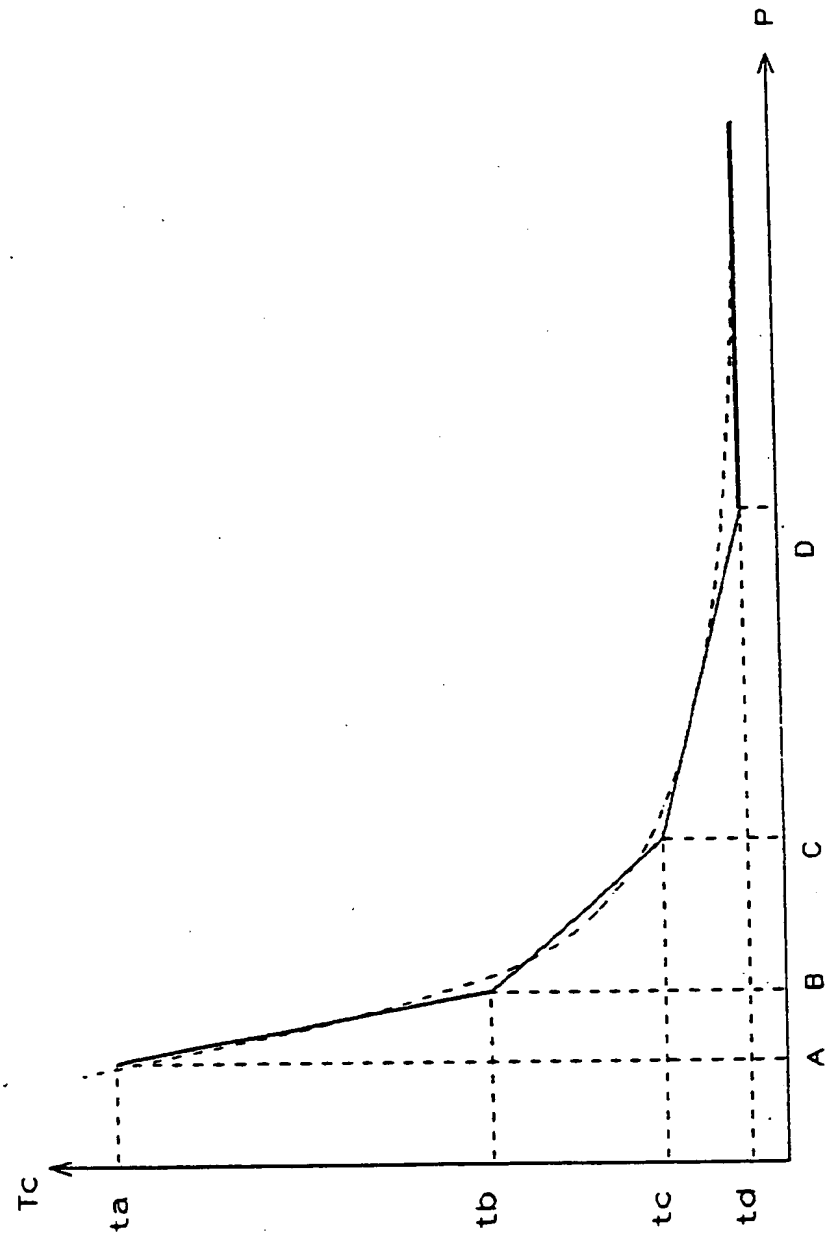

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number EP 93108248.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	WO - A - 88/10 020 (STAREC NOMINEES PTY, LTD.) * Page 7, lines 8-23; page 10, line 33 - page 13, line 5; fig. 4; claims 1,3,4, 6,8,10,13,14,16 *	1	H 02 J 13/00 H 02 J 3/14 H 03 K 17/18
A	WO - A - 92/05 616 (HAWKER FUSEGEAR LTD.) * Page 7, line 5 - page 8, line 10; fig. 1; claims 1, 2,7 *	1,2,3	
A	GB - A - 2 188 799 (P.H. BERTENSHAW, J. JONES) * Page 2, left hand column, line 32 - page 2, right hand column, line 92; fig. 1; claims 1,6 *	1,2,3	
A	DE - A - 4 212 063 (GENERAL ELECTRIC CO.) * Column 4, line 54 - column 5, line 20; fig. 4; claims 1,11,12 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.5) H 02 J H 03 K
A	US - A - 4 216 384 (HURLEY) * Column 4, line 21 - column 5, line 50; fig. 2; claims 1,3,9,11,15,16 *	1	
A	EP - A - 0 408 472 (EUROTHERM AUTOMATION S.A.) * Page 3, lines 33-57; fig. 1; claims 1,3,10 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	07-09-1993	MEHLMAUER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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